2.0 CONFIGURATION MANAGEMENT BASELINE

Beginning with the first distribution of BRAWLER outside of Air Force Studies and Analyses Agency (AFSAA) in the early 1980's it became quickly evident that configuration management procedures would be required in order to manage user sponsored enhancements, track error corrections, create accurately configured system tapes for users, and provide timely documentation of users.

The focal point for CM is the AFSAA, which has provided continuous support for BRAWLER development since 1976. As such, they organize annual user group meetings, determine the content and timing of new versions (in response to user needs), and prioritize model development. The primary development versions of BRAWLER currently reside at the Decision-Science Applications, Inc. (DSA) offices in Arlington, Virginia. It is there that copies of all released versions of BRAWLER and documentation are maintained. Versions of the model distributed by SURVIAC are derived from the DSA versions. Procedures for bug reporting and correction have been in place for a number of years. These procedures utilize on-line tracking software in place at the DSA facility. Documentation consists of a Management Summary Manual, Analyst Manual, User Manual, and Programmer Manual. All manuals are currently maintained in Microsoft Word with figures in Microsoft Powerpoint. All documentation is available in hard copy format. However, beginning with V6.2, the most important sections of the User Manual will be available in hypertext format compatible with the software package Framemaker. Based upon user response to the hypertext format, the remainder of the User Manual, as well as other documents, may become available in Framemaker.

The sections which follow provide a short description of the model, a reconstruction of the history of the model, a current version description, a description of the procedures in place for changes to the model, a listing of the current user support functions, and an assessment of the CM procedures which may affect model usage.

2.1   MODEL DESCRIPTION

2.1.1   General Descriptions

The BRAWLER model is a comprehensive computer simulation tool that provides a detailed representation of air-to-air combat involving multiple flights of aircraft in both the visual and beyond-visual-range (BVR) arenas. In such engagements cooperative tactics and human factors such as surprise, confusion, and limited situation awareness play a critical role in determining combat outcomes. Accordingly, special emphasis has been placed on carefully simulating these aspects of the engagement process. In addition, a high level of detail is achieved in the hardware models, including those of aircraft aerodynamics, missiles, guns, expendables, radars, missile launch warning devices, radar warning receivers, IRST, IFF, NCID, etc. Electronic countermeasures versus radars, missiles, and communications are also handled. Hardware models are largely data driven, and data bases describing most current generation US and threat systems for air-to-air engagements are available. The modular nature of the BRAWLER model facilitates the incorporation of new hardware models at various levels of fidelity. Unclassified databases describing aircraft, weapons, avionics, etc. are available through DSA or SURVIAC. Classified

databases for hardware are available through AFSAA (blue systems) and NAIC (red systems).

2.1.2   Typical Uses

BRAWLER is used in much the same way as one would use a combat exercise or flight test. Each run of BRAWLER simulates a single multi-aircraft engagement. Just as a succession of trials in a field exercise will produce very different outcomes, repeated runs of BRAWLER (using different random number sequences), will produce very different engagements. Therefore, BRAWLER users normally generate multiple replications of a mission in order to fully explore the set of possible outcomes. Analysis is facilitated by interactive graphics that permit displays of engagements from many perspectives, and by a report generator that produces statistical analyses of ensembles of engagements. In cases where it has been possible to compare BRAWLER with field exercises or man-in-the-loop simulations, the statistical distribution of outcomes produced by the model have been quite close to those produced using human pilots.

BRAWLER, originally called TAC FLIGHT and later TAC BRAWLER, was originally developed as a test of the artificial intelligence concepts or value-driven decision making and information-oriented simulation architectures. Initially, its capabilities were limited to within visual range (WVR) gun duels with only loose cooperation among aircraft. Currently, typical applications of BRAWLER include hardware design trade-off studies for airframes, avionics and weapons systems, and tactics development. The emphasis is usually on hardware effectiveness in a realistic mission context. For example, a proposed radar system might have an increased field-of-regard. BRAWLER could determine the degree to which this improvement enhances the ability to perform a specific mission. Recent BRAWLER use has included trade-off studies relating to the AMRAAM, and design studies for both the ATF program and for advanced avionics programs such as INEWS. BRAWLER has been embedded as an intelligent target generator in several manned simulator facilities, where it enhances the ability to simulate large engagements. Recently BRAWLER has been confederated with other simulations such as EADSIM through the use of DIS (Distributed Interactive Simulation) protocols. In this configuration, the theater level model EADSIM transfers control of flights of aircraft to BRAWLER whenever air-to-air engagements appear imminent and BRAWLER returns control to EADSIM when the engagements are completed.

2.1.3   Platforms and System Requirements

BRAWLER should be easily adaptable to run on any computer provided with full standard FORTRAN '77 and ANSI C compilers and adequate memory. The preferred platforms for BRAWLER are UNIX platforms. The SUN and Silicon Graphics workstations provide excellent matches to BRAWLER requirements, with the choice between SUN and Silicon Graphics made on the basis of user graphics requirements. Memory requirements depend upon the requirements for the operating system and the user load expected on the machine; typical BRAWLER UNIX installations occur on machines with from 32 to 64Mb of main memory. As for disk requirements, the ultimate needs are not determined by the size of BRAWLER, but by the amount of output which the analysts need to save for data reduction during studies. Exclusive of space required for other system resources, 500 Mbytes of storage are recommended for BRAWLER and its output in order to perform significant studies.

UNIX platforms are preferred because of the availability of a UNIX-based BRAWLER configuration management and analysis support environment (DSA_Environment), and because UNIX supports the general flexibility needed for BRAWLER analysis. However, BRAWLER has been used on many other platforms, including various VAX/VMS systems (11/7xx, microVAX, 8600, 8800), several IBM computers (3032, 3081, 4341, 3090, and Gould Sels (9780).

2.2   DEVELOPMENT HISTORY

The BRAWLER simulation grew out of the model FIMOD during the mid-1970's. During this period AFSAA, under the direction of Gen. Jasper Welch, initiated an effort to develop a multi-aircraft engagement model based on the artificial intelligence concepts of "value-driven decision making" and "information oriented architecture" (see BRAWLER Analyst Manual). The early versions of the model, used only by AFSAA, were resident on the Air Force Multics computer system at the Pentagon. Although primarily written in FORTRAN, the model contained some PL/1 code and a number of system calls which tied it closely to the Multics system. By the early 1980's, it became evident that there were a number of organizations outside of AFSAA interested in the model. As a result of its non-portability, DSA internally funded a re-write of the model in FORTRAN 77. DSA established rights to BRAWLER at this point and licensed its use to commercial organizations; the government continued maintained access without a license. During the mid-1980's there was a significant increase in development support for the model from both the commercial and government sectors. Many of the commercial enhancements which were proprietary had limited distribution. In addition, DSA undertook internal funding for a number of enhancements which could not be funded from government or commercial sources. These enhancements were also proprietary and licensed. By the mid to late 1980's, it became evident that the proliferation of proprietary enhancements (including proprietary enhancements belonging to a number of user organizations) had made BRAWLER standardization very difficult. For efforts such as the ATF and other programs, AFSAA and other government organizations determined which configuration of the model would be used for studies in those programs. Concurrently, a number of the proprietary enhancements to the model moved into the public domain. Finally, in 1994, with the movement of BRAWLER into SURVIAC, the government obtained unlimited rights to the model.

Table 2-1 which follows lists the dates when various versions of the model were frozen and released. The preponderance of "freeze" dates within a month of "release" dates in the table is due to earlier release procedures. Until very recently, testing for a new release was performed at DSA and the date associated with "freezing" was the date when testing ended. The first shipment of the model generally occurred within that month or the next month. Current procedures (in place for V6.2) include freezing of the version prior to any beta site testing. The long delay between freezing and release for V6.2 was due to 2 factors: (1) an unusually long time taken to establish beta test sites, and (2) a requirement during the beta test period that a number of new enhancements be developed and included so that V6.2 could be used in the AIM-9X COEA.

TABLE 2-1. Brawler Version Release Dates.

Version	Date Frozen	Date Released
ATF1.0	May 88	Unknown
ATF1.1	Aug 89	Jan 90
V6.01	Jul 91	Aug 91
V6.02	Aug 91	Aug 91
V6.03	Sept 91	Sept 91
V6.04	Nov 91	Dec 91
V6.1	Dec 91	Dec 91
V6.11	Feb 92	Feb 92
V6.12	Apr 92	Apr 92
V6.13	Jul 92	Jul 92
V6.14	Nov 92	Nov 92
V6.14A	Nov 92	Dec 92
V6.15	May 93	Oct 93
V6.2	Aug 94	Oct 95

The following Tables 2-2 through 2-7 list enhancements which appeared in various major versions of the model. These lists are much more complete for more recent versions of the model as configuration management and tracking of this information has improved over the years.

TABLE 2-2. Enhancements for V6.2.

Area	Enhancement
DIS Interface	Model capable of confederation with EADSIM
Missile	Enhanced fidelity of missile seeker simulation prior to launch
	New variable flow ducted rocket throttling algorithm
	Updated AMRAAM guidance law
	Add separate gimbal limit applied prior to launch
RWR	Enhanced flexibility in specifying ID capabilities
Utilities	Expanded missile trajectory output files
Radar	Specification of initial PRF mode in SCNRIO file
Graphics	Seeker direction can be displayed when seeker ON prior to launch
Expendables	Can be configured as controllable from within cockpit

TABLE 2-3. Enhancements for V6.15.

Area	Enhancement
Missile	IR missiles now capable of variable clutter rejection
Aircraft	Added maximum internal fuel capacity to aircraft description

TABLE 2-3. Enhancements for V6.15.

Area	Enhancement
Production Rules	New handler to allow user to send observation messages.
Data	New data set for AIM-9M added to STORED file.

TABLE 2-4. Enhancements for V6.14A.

Area	Enhancement
Missile	Added capability for multi-engine missiles
	Added options for control of missile between separation and guidance initiation
	Added option for controlling post-stall missile launches

TABLE 2-5. Enhancements for V6.14.

Area	Enhancement
Maneuvering	Added new missile aiming maneuver
Missile	Added arming time to missile specification

TABLE 2-6. Enhancements for V6.13.

Area	Enhancement
Situation Assessment	Added a third type of ID rules of engagement
Scenario	Allow IRST devices at GCI sites
egmain utility	Allow control of min G's at endgame; add new options for initial launch geometry; allow generation of multiple history files.

TABLE 2-7. Enhancements for V6.12

Area	Enhancement
	No record available of enhancements for this version.

2.3 CURRENT VERSION DESCRIPTION AND STATUS

The version of BRAWLER currently in distribution is V6.2, which was released in November, 1995. A list of configurable items for the model follows. Note that BRAWLER consists of a large set of utility programs in addition to the main BRAWLER program *tbmain*. The source code and include files for all programs are each distributed in single

files. Hence one cannot refer to each program as a configurable item - all of the source is considered a configurable item.

The configurable items listed in Table 2-8 below can be divided into two categories: files provided on a distribution tape of BRAWLER and hardcopy documentation available for BRAWLER. Note that many of the files are described as Unix-specific (Unix scripts and lists for the Unix archive command, etc.). These are provided to users since the overwhelming number of installations are on Unix machines.

TABLE 2-8. Brawler Configurable Items.

Configurable Item	Item Type	Class	Description
LIBGCS	File	U	List of all graphics routines which are normally part of the Unix library *libgcs.a*
LIBMAIN	File	U	List of all of the main programs which are normally part of the Unix library *libmain.a*
LIBTB1	File	U	List of all of the BRAWLER routines which normally reside in the Unix library *libtb1.a*
LIBTB2	File	U	List of all of the BRAWLER routines which normally reside in the Unix library *libtb2.a*
LIBTB3	File	U	List of all of the BRAWLER routines which normally reside in the Unix library *libtb3.a*
LIBTB4	File	U	List of all of the BRAWLER routines which normally reside in the Unix library *libtb4.a*
LIBUTIL	File	U	List of all of the BRAWLER routines which normally reside in the Unix library *libutil.a*
brkfil.f	File	U	A program used during the installation process to break apart other files.
convert.doc	File	U	Documentation for data conversion programs provided with new version.
convert.tape	File	U	A concatenation of data conversion programs provided with the new version.
data.tape	File	U	A concatenation of BRAWLER input files.
dbxlist	File	U	A list of routines which should be compiled with the Unix debugger dbx.
doc.tape	File	U	A concatenation of documentation files for each include file.
gfxinc.tape	File	U	A concatenation of documentation files for each graphics include file.
graphics.tape	File	U	A concatenation of all graphics source files.
include.tape	File	U	A concatenation of all include files.
install_br	File	U	The installation script
makelib_br	File	U	The script used to construct Unix libraries.
opt0list	File	U	The list of routines which should be compiled with optimization zero.

TABLE 2-8. Brawler Configurable Items. (Contd.)

Configurable Item	Item Type	Class	Description
secsrc.dir	File	U	A list of secret routines.
secsrc.tape	File	S	Concatenation of secret source routines.
source.dir	File	U	List of non-secret source files.
source.tape	File	U	Concatenation of non-secret source files.
util.dir	File	U	List of utility routines
util.tape	File	U	Concatenation of utility routines.
xref.tape	File	U	Concatenation of cross reference files.
Management Summary Manual	Hard Copy	U	A short, high-level description of the capabilities and important decision algorithms used in Brawler appropriate for managers to determine applicability.
Analyst Manual	Hard Copy	U	Provides nonprogramming analysts with the details of the algorithms used in the model, a description of the scope and content of the input and output of the program, and the techniques employed for model verification and validation.
User Manual	Hard Copy or Framemaker	U	Provides nonprogramming users with the information that will allow them to utilize the model for application purposes. It includes enough data about Brawler for a user to determine its applicability to his problem, data preparation procedures, run procedures, and output analysis procedures.
Programmer Manual	Hard Copy	U	Presents specific techniques used in BRAWLER for the modification, error correction, and extension of its computer code. It is for use by programmers who wish to make such modifications and by analysts who require additional detail on the methodology used in BRAWLER
Accompanying Doc.	Hard Copy	U	"Accompanying Documentation for BRAWLER Version V6.X Release." Copies of most frequently changed documentation sections.
Release Notes	Hard Copy	U	"BRAWLER Version V6.X, Release Notes." Contains descriptions of bugs fixed, new enhancements, data conversions which must be performed, and known problems for each version.

Except for LIBUTIL (which contains low level utilities) and LIBGCS (which contains a list of graphics routines), the other library lists (LIBTB1 through LIBTB4) do not contain lists of routines that are functionally related. The routines in these four lists are determined by *load ordering*, that is, the membership in these lists is set by the requirement that the loader retrieve required modules in a single pass through the libraries associated with these lists. Simply stated, a routine in library "3" will not call a routine in library "1" or "2" (there are exceptions).

2.4   CHANGE PROCEDURES

2.4.1   CM Organization

In its current form, the configuration management organization is rather informal and compact so that an organization chart is not required. All decisions regarding configuration management are ultimately made or agreed upon by the Configuration Manager at AFSAA (currently Maj. Al Gracia), frequently in consultation with the developers and integrators at DSA. These decisions include:

    a.   Naming designators for new versions.
    b.   Timing of new version releases
    c.   Distribution of beta test versions
    d.   Determination of enhancements to be included in new versions
    e.   Prioritization of bug fixing

AFSAA is currently reviewing the current organization and procedures with a view to the possible establishment of a configuration control board (CCB).

2.4.2   Configuration Management Software

All aspects of configuration management of the actual code are performed using the software package DSA_Environment   developed at DSA. This software consists of UNIX scripts, aliases, a directory structure, etc., and is used for tracking of software fixes, tracking of software enhancements, maintaining simultaneous versions, tape creation for users, as well as providing for selective code generation. This last capability allows automatic generation of source code for specific destinations or machines from the same source code. Typical examples of such a need are differences in code for SUN or SGI machines, or non-public domain enhancements which have been integrated into the code at the DSA site. Detailed descriptions of the DSA_Environment   capabilities used for configuration management can be found in Appendix A.

2.4.3   Version Control

The current method of version control has evolved dramatically over the period during which BRAWLER use has expanded. The components of the system for version generation are conceptually quite simple. All enhancements and bugfixes are made in a version of BRAWLER labeled "devel." Usually a new version is targeted for a particular set of enhancements. When these enhancements are completed, a new version is "frozen" by copying the current version to a new version, for example V6.X. This process can proceed even if other enhancements are in progress in the "devel" version which are not targeted for the new version. The configuration management software insures this isolation. During the beta test period, a number of errors are reported to DSA and AFSAA. As these bugs are fixed (in both the DSA devel version and the DSA V6.X version) using the procedures described below in the bugfix section, upgrade tapes are sent to beta sites to insure that they all maintain equivalent systems. At the end of the beta test period the new version becomes available for general distribution. Copies for SUN and SGI are sent to SURVIAC for secondary distribution.

Beta test sites must agree to a "Beta Testing Rules" document issued by AFSAA. The form of the document as used with V6.2 is shown below in Figure 2-1.

Brawler Version 6.2
BETA TESTING RULES

To All BRAWLER Beta Testers:

Here are the Rules of Engagement for the pre-release testing of Version 6.2.

OBJECTIVE:

- To release high quality simulation code to the entire BRAWLER community.

SPECIFICS:

- Run in scenarios that you would use for analysis
- Use real data to the maximum extent possible

CRITERIA:

- No more than 5% bomb rate due to BRAWLER code failure.
- Unmodified V6.15 capabilities must work the same in V6.2

  - Results in unmodified areas must match between V6.15 and V6.2
  - Any previous capability must still work

- Any enhanced capability must move results closer to reality
- New capabilities must match reality at least at the gross effects level

PROCEDURES:

- After you sign this paper and send it back to AFSAA, you will get a <u>tape from AFSAA</u>

- You may put the code on any machine(s) you normally use for BRAWLER work.

- Wring out the code

- When you find errors (and you will), send them and possible fixes to AFSAA right away.

  - If you find a problem, but don't have the solution, AFSAA/SAGW will attempt to find a solution.

  - When solutions are found, AFSAA will send the fixes to all beta testers.

FIGURE 2-1. Beta Site Agreement.

- At the end of beta testing, you will be sent a copy of the released version. You are to remove beta-test version software from all machines within 30 days of receipt of the released version.

PHILOSOPHY:

- The purpose is to serve the whole community -- keep the big picture.

- We want to release this version in two to four months, so balance your effort to that goal.

ARBITRATION:

- If minor problems arise that cannot be solved in a reasonable time, those problems will be solved in the next version. However, decisions of AFSAA are final.

COMMUNICATION:

Phone: (703)697-5677
DSN: 227-5677
FAX: (703)697-1226
INTERNET: towe@afsaa.hq.af.mil

Thank you for participating.

RUSSELL L. TOWE, Major, USAF
BRAWLER Configuration Control Board Chairman

_____

TO: AFSAA/SAGW
     1570 Air Force Pentagon
     Washington, D.C. 20330-1570
     Attn: Major Towe

I understand and accept these terms. I would like to participate in the beta-testing of BRAWLER V6.2.

SIGN

FIGURE 2-1. Beta Site Agreement. (Contd.)

The beta test sites for V6.2 were:

Modeling, Analysis and Simulation Center (MASC)
U.S. Air Force Materiel Command
ESC/XRPM
Hanscom AFB, Ma. 01731
POC: Capt. Hal Sommer

China Lake
Naval Air Warfare Center
Weapons Division
Code 3943
NAS, China Lake, CA 93555
POC: Steve Howe

McDonnell-Douglas
P.O. Box 516 MC 0642233
St. Louis, MO 63146
POC: Paul Davis

Headquarters, U.S. Air Force
ACC/XP-JSG
204 Dodd Blvd., Suite 202
Langley AFB, VA 23665
POC: Capt. Karen Childers

2.4.4   Audit Trails

All source code and include files associated with Brawler contain embedded audit trails which contain a description of the change being performed, the name of the programmer making the change and a date/time stamps associated with the change. In addition, whenever a tape containing a version of BRAWLER is exported, a line in the audit trail is added which identifies the version, destination of the tape, and a date/time stamp. A detailed description of how the DSA_Environment software enforces maintenance of the audit trail can be found in Appendix A.

2.4.5   Enhancements

Implementation and integration of BRAWLER enhancements is controlled by the configuration management software which maintains separation among simultaneous enhancements, automates documentation of enhancements, and provides version control. Isolation of development implies that several enhancements can be developed independently without interference. Detailed descriptions of the enhancement process can be found in Appendix A.

2.4.6   Bug Fixing

The procedures for reporting suspected errors, tracking responses, and insuring that changes (fixes) appear in new versions have been developed over a period of years. A considerable amount of software is dedicated to tracking of model changes. When a

suspected bug is reported to DSA, a manual entry is made in a notebook listing the date of the report, the person taking the call, the reporting analyst and organization. A "bug" number is assigned at that time. From this point, all tracking is performed on the same computer system on which BRAWLER resides. A "hotline" form is opened on-line for this bug number as described in Appendix A. These forms eventually become the basis for error correction documentation distributed with the next version.

2.5   USER SUPPORT FUNCTIONS

2.5.1   Training

DSA provides two levels of BRAWLER training to interested organizations. The Basic training program, which lasts four days, is intended for analysts or programmers who have had little if any BRAWLER experience. The capabilities of the model are described, including a demonstration on the local computer system, if possible. The various hardware models that are part of BRAWLER are discussed in detail, as is the decision logic used by the pilot model and how Production Rules may be used to modify pilot decisions. Configuration and content of input and output files is discussed, with particular emphasis on the files most likely to be modified by the participating companies. The use of the many analysis tools that are part of BRAWLER and commonly used programming techniques are discussed, along with the use of the BRAWLER utilities library. In addition, installation issues are discussed in as much detail as is appropriate to the needs of the participating companies at their facility. This course is generally held at the DSA facility whenever the number of interested students reaches a threshold, generally twice per year. Occasionally the course is held at a user site if desired and numbers warrant.

The Advanced Course is intended to focus attention on a "real" application of the user. This informal course is generally held at the user's site and is conducted by a senior DSA BRAWLER analyst. The typical duration is from 3 to 5 days. This class emphasizes the use of the BRAWLER production rule facility, with particular attention to the types of scenarios likely to be encountered by the individual participating companies. The class begins with a classroom lesson on the Production Rule facility. The remainder of the course consists of a hands-on exercise in which the class learns to use the Production Rule facility by building and fine-tuning a realistic RULES file. To best benefit from the class, attendees should have some working knowledge of BRAWLER, including some familiarity with variables used by the decision logic and with commonly-used utility subroutines (e.g. *xmit, vsub, match*).

The training coordinator at DSA is Ms. Patricia Paratore who may be reached at 703-243-2500 or *pparatore@dsava.com*.

2.5.2   User Group Meeting

BRAWLER User Group meetings are generally held once per year, usually at the ANSER facility in Crystal City, Arlington, Virginia. The meeting is organized by AFSAA and SURVIAC and has, in recent years, lasted two days. The agenda covers discussions of recent uses of the model, descriptions of new enhancements, user enhancement priorities, and tutorials. To be added to the mailing list for this meeting, one should contact Linda Hamilton at SURVIAC (513-429-9509).

2.5.3   BRAWLER Bulletin Board

The BRAWLER BBS is located at DSA in Arlington, Va. It is currently used to (1) Post notices and announcements to users, (2) Provide a list of bugs which have been fixed in the model and the version which will reflect each fix, and (3) Provide a general FTP capability for the transmission of files between users and DSA analysts. Insofar as the BBS has no continuing support, its maintenance is funded through a percentage of the costs of Maintenance Agreements which DSA has with BRAWLER users. As a result, access to the BBS is limited to those who provide support for its existence.

2.5.4   BRAWLER Service Agreements

New as well as experienced users of any model require "hotline" type assistance from time to time. Although BRAWLER is currently a SURVIAC model, this acceptance has only occurred recently. As a result, the SURVIAC staff expertise with the model internals will be limited until they gain further experience. Consequently, the source of quick-response assistance for BRAWLER is with the developers at DSA. Since there has been no funding available to provide such help on a community-wide basis (the exception being funding provided during the ATF selection process to support all ATF users), DSA developed several means by which organizations could establish relationships specifically oriented to providing telephone support.

DSA has developed the *Basic Service Agreement* which provides up to fifty (50) hours Consulting Service to assist customers in using the BRAWLER software and also supplies them with additional BRAWLER tapes as needed

Expanded Support provides expanded technical support services not covered under the Basic Service Agreement. In this case the *Expanded Support* can be used as a vehicle to acquire additional support for services not covered under the Basic agreement such as:

- Software development
- Detailed RULES development
- Creation of hardware data tapes
- Analysis support
- Conduct studies

Detailed information on these service agreements is available from Ms. Patricia Paratore at DSA, 703-243-2500 or *pparatore@dsava.com*.

2.6   IMPLICATIONS FOR MODEL USE

As with any model under consideration for use by the community, consideration must be given to the quality of the configuration management and user services available for the user. Given the expanded use of BRAWLER during the 1980's, a parallel development of configuration management occurred. In particular, software is in place to perform many CM functions including selective source generation, tape generation, bugfix documentation and tracking, enhancement documentation and tracking, etc.

Users considering the use of BRAWLER must determine whether the current release version is sufficient for their needs. This can be determined from the information contained

in the "Release Notes" associated with each version that describes the differences from the previous version. Timing of studies can also be affected by version release dates. The Air Force attempts to average one new release per year, so users can make a rough judgment of when the next version should appear.

An evaluation of particular issues follows:

"Maintains master copies of the released code version and any associated documentation."

Master copies of the last five versions of BRAWLER are maintained on the computer systems at DSA. DSA analysts are thus able to execute and debug virtually any version of the model which may be in the field. Versions which are even older are maintained off-line on tape media. Documentation source is maintained on-line in Microsoft Word in separate directories for each version.

"Controls the preparation and dissemination of changes to the master copies of released software and documentation so that they reflect only approved changes."

In order to insure that only approved changes appear in the next version of the model, the CM system requires that a user perform a number of steps in order to update the current archives which will eventually become the next version. At the point in time when a new version is to be "frozen", a review of all enhancements in progress is made to ensure that those not complete are not required in the new version. The CM system is structured to prevent a partially completed enhancement from existing in the archives of the current "devel" version.

In order for a programmer to inadvertently make permanent changes to a version which is already "on the street", additional manual steps in CM system are required which would alert the programmer that changes are being made in a version other than the "devel" version. Such a change is not expressly forbidden since it is possible that a serious bug is discovered in a just-released version which requires immediate correction.

"Provides for routine and timely processing of trouble and change reports"

Procedures described above insure that reported bugs enter the automated tracking system when they are reported. Prior to "freezing" of new versions, DSA_Environment software reviews all existing on-line "bugfix" forms and generates a report of all bugfixes which have not been completed. These are reviewed manually to determine if they are required for the new version.

"Provides for promulgation of change notices and regularly updated documentation"

It is the intention of the configuration manager to generate new versions of the model (and documentation) at approximately one year intervals. The distribution of changes to the model between official version is generally frowned upon, except when severe errors are present. To minimize the chances of such an occurrence, specific tasking exists to provide exhaustive model exercise with stressing scenarios prior to release to beta sites.

Over the past few years, funding for documentation has been limited. As a result, the focus of documentation expenditures has been on the User Manual since it is most important to the community. Thus the User Manual associated with recent versions has been current; however, the Analyst and Programmer Manuals delivered with recent versions have been known to be deficient. Some funding has been used to review the programmer manual and develop a roadmap to bring it more up to date, however, the actual implementation has not occurred.

"Assures that software, media, and documentation are properly identified."

As described earlier, each software element (source file or include documentation file) contains within its internal audit trail, a line inserted during tape generation which includes the version of the model, a date/time stamp, and the destination of tape. Every page of documentation contains a footer which shows the version with which it is identified.

"Assures that all approved changes have been incorporated in both the software and documentation."

The on-line forms for tracking enhancements contains sections which the programmer must fill out after completing changes to each of the documentation elements (analyst, user, programmer manuals). Those changes are made in the "devel" version of the documentation. When that version becomes version V6.X, that documentation automatically transitions to that street version.